4.2 Integrated Technical Planning (Satisfies Criteria of EIA/IS731 FA 2.1 and iCMM PA 11)

4.2.1 Introduction to Integrated Technical Planning

Integrated Technical Planning is the tactical and strategic means of defining problems, forecasting conditions, and coordinating program elements to maximize program focus on providing superior products and services. The Integrated Technical Planning process provides the guidance and tools to track and manage program activity, as well as the program-specific process tailoring to optimally satisfy program needs. This System Engineering (SE) element has been subdivided into two primary areas: plans and reviews. The plans include the Integrated Program Plan (IPP) and supporting technical plans such as the System Engineering Management Plan (SEMP), Master Verification Plan (MVP), the Integrated Safety Plan, and so forth. The review section contains both design reviews and audits. This section includes all planning documents; specific development details are in Appendix E. Perform tailoring on planning documents only by deleting planning requirements; provide a rationale for each deletion. The only allowable additions are those unique to the program and formally required by the stakeholders. The size, complexity, and visibility of a program will determine which SE elements need to be supported by more detailed planning documents. Integrated Technical Planning applies to all programs/projects regardless of size, whether or not they are new programs or changed or derivative projects. The size and scope of planning may change to meet program needs. A change to a program with an existing IPP, SEMP, or other plans only requires documentation that existing plans still apply. On any existing program, the current plans should be referenced in all new plans developed.

4.2.1.1 Integrated Technical Planning Objective

The objective of the Integrated Technical Planning process is to provide program management with a sound, repeatable method for executing requirements-based and structurally managed programs.

4.2.1.2 Process-Based Management

The Process-Based Management (PBM) chart appears in Figure 4.2-1.

Process:

Perform Integrated Technical Planning

ID No.: 4.2 (iCMM PA 11)
Date: April 25, 2000
Revision Date: September 30, 2004

Next Higher Level Process:

Perform System Engineering

Process Owner:

System Engineering Council

Process Objective:

Provide program management with a sound, repeatable method for the execution of a requirements based and structurally managed program.

Inputs

a) FAA policy
b) Integrated program schedule
c) Corporate strategy and goals
d) Planning criteria
e) Concept of operations
f) NAS CONOPS
g) Analysis criteria
h) Mission need statement

Providers

a) EXT
b) EXT
c) EXT
d) RM, FA, Syn, TS, IM, SpecEng, IA, RSK, CM, V&V, LCE
e) FA
f) FA
g) IA
h) RM

PROCESS TASKS

Beginning Boundary Task

Develop IPP and supporting technical plans

- Perform SE planning
- Perform specialty planning
- Perform lifecycle planning
- Develop MVP
- Develop SEMP
- Develop integrated lifecycle plan
- Integrate planning into IPP

Ending Boundary Task

Plan and perform reviews and audits

Lifecycle Phase

- ☑ Mission Analysis
- ☑ Investment Analysis
- ☑ Solution Implementation
- ☑ In-Service Management
- ☑ Service Life Ext.
- ☑ Disposal

Outputs

a) Integrated program plan
b) NAS Architecture
c) SEMP
d) Constraints
e) Concerns/issues
f) Master verification plan
g) Integrated lifecycle plan
h) Supporting technical plans
i) CM Plans, Audit results

Customers

a) EXT, RM, FA, Syn, TS, IM, SpecEng, IA, RSK, CM, V&V, LCE
b) RM, IM, SpecEng, CM, V&V, LCE
c) EXT, RM, FA, Syn, TS, IM, SpecEng, IA, RSK, CM, V&V, LCE
d) TS
e) RSK
f) V&V
g) LCE, RM, SpecEng, TS
h) EXT
i) CM, EXT

Figure 4.2-1. Integrated Technical Planning Process-Based Management Chart

4.2.1.3 Inputs to Integrated Technical Planning

The inputs to the process at this level appear in the PBM chart. Some of these inputs provide requirements, while others impose constraints.

4.2.1.4 Integrated Technical Planning Process Tasks

The PBM chart shows process tasks.

4.2.1.5 Outputs of Integrated Technical Planning

The PBM chart shows a summary of the output for this process. Details of the outputs appear later in this section.

4.2.1.6 Integrated Technical Planning Process Metrics

The metrics for performing the Integrated Technical Planning process are listed with each specific plan.

4.2.1.7 Integrated Technical Planning Tools

Integrated Technical Planning requires word processing, display, and scheduling tools.

4.2.1.8 Key Decisions

Key decisions required for this process are:

- Request by stakeholders and/or program manager for Integrated Technical Planning (usually included in the IPP and SEMP)
- Identification of necessary planning elements by the program system engineer and the project team
- Program manager acceptance that the identified planning elements are necessary
- Baseline plan accepted by the program manager, stakeholders, and the Joint Resources Council (JRC)
- Program manager's approval of the IPP, MVP, SEMP, and any other supporting technical plans

4.2.1.9 Key Process Interfaces

Integrated Technical Planning interfaces with all other SE processes, either receiving inputs from them or providing outputs to them.

4.2.1.10 Acquisition Management System Process Interface

Chapter 3 describes the Acquisition Management System (AMS) process interface. AMS process activities that most strongly interact with the SE must be taken into account in the Integrated Technical Planning process. All plans are living documents and are subject to continuous review and update to satisfy program needs and changes. All available plans

should be reviewed at each AMS milestone and as part of subsequent system baseline modifications throughout the program lifecycle.

4.2.2 Integrated Program Plan

The IPP is the primary document within the AMS for planning the actions and activities to execute the program within the cost schedule, benefits, and performance baselines. A draft IPP is completed by JRC 2a and the final IPP is approved at the Final Investment Decision (JRC 2b). The IPP is reviewed and updated at all subsequent phase reviews and reflects changes throughout the program's lifecycle.

4.2.2.1 Introduction to the Integrated Program Plan

The IPP is the recognized plan used to manage a project and contains the Integrated Program Schedule, which encompasses milestones (events), accomplishments, and criteria. The IPP relates accomplishments to program events and demonstrates a logical, event-driven sequence of effort. It is directly traceable to the Work Breakdown Structure (WBS) and Statement of Work (SOW). The IPP provides vertical and horizontal integration traceability through its task statements and numbering system and identifies task relationships. It facilitates resource planning, measuring progress against planned efforts and problem identification, as well as providing time-phased tasks and a framework to develop recovery and workaround plans. The IPP reflects contractual requirements and unique programmatic requirements. To ensure that all planning is referenced in the IPP, the planning elements contained in the tailored SEMP, MVP, and ILCP will, at a minimum, be documented in the IPP. Table 4.2-1 lists the sections of an IPP.

Table 4.2-1. Integrated Program Plan Table of Contents

Integrated Program Plan Table of Contents	
1	BACKGROUND
1.1	Mission Need
1.2	Status
2	OVERVIEW
2.1	Program Scope
2.2	Products
3	INTEGRATED PROGRAM FUNDING
4	INTEGRATED PROGRAM SCHEDULE
5	PERFORMANCE
5.1	Core Work Activities
5.2	Program Management Work Activities
5.3	Procurement Work Activities
6	BENEFITS
7	PHYSICAL INTEGRATION
8	FUNCTIONAL INTEGRATION
9	HUMAN INTEGRATION

Integrated Program Plan Table of Contents	
10	SECURITY
11	SAFETY (frequently a separate plan — SSMP)
12	IN-SERVICE SUPPORT
13	VERIFICATION (INCLUDES TEST AND EVALUATION)
14	IMPLEMENTATION AND TRANSITION
15	QUALITY ASSURANCE
16	CONFIGURATION MANAGEMENT
17	IN-SERVICE MANAGEMENT
18	SYSTEM ENGINEERING MANAGEMENT PLAN
19	MASTER VERIFICATION PLAN
20	INTEGRATED LIFECYCLE PLAN

4.2.2.2 Inputs to the Integrated Program Plan

The following inputs are necessary to develop the IPP:

- Program objective as reflected in the top-level Mission Need Statement (MNS) and requirements documents, which detail the operational environments in which the system is expected to operate
- Program-specific guidelines
- Top-level program constraints and assumptions, including program-specific organizational constraints and assumptions to be used on the program
- Program-specific schedule constraints and events
- Concept approach, including top-level conceptual alternatives, functional analyses, design support alternatives, and initial system evaluations
- Any specified government or external standards to be employed on the program
- Any other supporting technical plans (e.g., MVP, SEMP) to be presented at the JRC 2b

4.2.2.3 Integrated Program Plan Steps

An IPP is the responsibility of program management, which often delegates the writing and coordinating to SE. The IPP is developed using the following steps.

4.2.2.3.1 Step 1: Collect Inputs

All program elements, both technical and nontechnical, are responsible for providing IPP inputs. The stakeholders provide the inputs identified in Paragraph 4.2.2.2 for every technical and nontechnical discipline involved. Inputs are also gathered from the Request for Proposal (RFP), SOW, WBS, organizational charts, Contract Data Requirements List (CDRL), and schedule information.

4.2.2.3.2 Step 2: Prepare Integrated Program Plan

The IPP must include accomplishments and criteria for each event, responsibility for each accomplishment, entrance and exit criteria, milestone linkages, and supporting narratives. Also

IPP tools must be selected, and a timetable for implementation prepared. Chapter 3, "System Engineering in the Acquisition Management System Program Lifecycle" (and Appendix F) provides some guidelines on the timing for developing various IPP drafts, with the final approved IPP required for the Final Investment Decision (JRC 2b). The AMS FAA Acquisition System Toolset (FAST) contains the IPP template.

4.2.2.3.3 Step 3: Coordinate and Baseline

The internal and external IPP stakeholders review drafts of the IPP. Once concurrence is obtained from the stakeholders, the IPP is approved at the JRC 2a and becomes the baseline IPP. SE coordinates IPP impacts and develops alternative strategies.

4.2.2.3.4 Step 4: Maintain Plan

The program progress is monitored continually throughout the life of the program. Changes in the program are reflected in the IPP, which is then coordinated for approval of the modifications.

4.2.2.3.5 Step 5: Provide Current Plan

The IPP is provided to all stakeholders.

4.2.2.4 Outputs of the Integrated Program Plan

There are five basic types of data in the IPP:

- **Data Type 1: Event.** This may be major program review, especially the AMS phase exit reviews, or they are subevents.
- **Data Type 2: Accomplishment.** An accomplishment is the end goal of any program task tied to the event. The accomplishment may be development of a deliverable or completion of an analysis or test.
- **Data Type 3: Success Criteria.** A success criterion is the measure of whether the accomplishment was met or not. The criterion may be completion of the task, delivery of a report, or completion of the test. Success criteria may also include quality measures, such as the success of a test or the approval of a report.
- **Data Type 4: Task.** A task is the activity required to accomplish the objectives tied to the event. The task statement should reference the applicable WBS and SOW elements.
- **Data Type 5: Subtask.** A subtask is a subdivision of the task described in the major task.

4.2.2.5 Integrated Program Plan Metrics

The primary IPP metric is publication and approval of the IPP at each AMS milestone. The IPP itself is a metric to evaluate the conduct of the program. The performance and conduct of the events, accomplishments, success criteria, tasks, and subtasks are program metrics.

4.2.2.6 Integrated Program Plan Tools

The primary IPP tool is a generic template for any project using the SE elements and is contained in the FAST Toolset under "Required Planning Documents." Specific projects may tailor this template to provide information pertaining to specific deliverables, tasks, and tools.

4.2.2.7 Integrated Technical Planning Inputs to the Integrated Program Plan

SE planning directly relates to elements of the SE process and is included as sections of the IPP. It describes how the SE process is applied to the given program or project at a summary level with detailed SE implementation activities discussed in supporting technical plans e.g., SEMP, MVP, etc). These planning sections become the tailored process. All IPP sections apply to every program; however, stakeholder direction or the nature of the program may dictate elimination of a planning section. For example, a program without any avionics interfaces does not require a certification planning section. The program system engineer documents the rationale for eliminating any IPP sections or tailoring any process, and the program manager approves these actions. It is recommended that, as part of the IPP, these planning sections be reviewed and changed whenever dictated by a change in the program or discovery of a discrepancy in the IPP. Changes to any planning sections shall be coordinated with the SEMP, MVP, and other associated plans. All plans shall be reviewed before each JRC milestone. After any plan is created following the SEM, it is recommended that the plan be provided as reference material for future plan developers. It is recommended this be done through SE. It is also recommended that, along with the plan to be achieved, comments are provided to continue improvement of the plan development process. Table 4.2-2 lists the sections of an IPP and the SE elements from the SEMP that provide summary-level inputs to the applicable IPP sections.

Table 4.2-2. SE Inputs to the Integrated Program Plan

Integrated Program Plan		System Engineering Element
1	BACKGROUND	
1.1	Mission Need	Requirements Management
1.2	Status	Integrated Technical Planning (ITP)
2	OVERVIEW	
2.1	Program Scope	ITP
2.2	Products	ITP
3	INTEGRATED PROGRAM FUNDING	EXTERNAL
	INTEGRATED PROGRAM SCHEDULE	ITP
5	PERFORMANCE	
5.1	Core Work Activities	ITP; Functional Analysis (FA); Synthesis (Syn); Trade Studies (TS); Interface Management (IM); Integrity of Analyses (IA); Specialty Engineering (SpecEng) — Reliability, Maintainability, and Availability (RMA) and Quality Engineering))
5.2	Program Management Work Activities	Requirements Management (RM); SpecEng (System Safety); Risk

Integrated Program Plan		System Engineering Element
		Management (RSK))
5.3	Procurement Work Activities	ITP
6	BENEFITS	RM
7	PHYSICAL INTEGRATION	Lifecycle Engineering (LCE — real property; deployment and transition); SpecEng (Hazardous Materials Management/Environmental Engineering and Electromagnetic Environmental Effects (E3))
8	FUNCTIONAL INTEGRATION	IM
9	HUMAN INTEGRATION	SpecEng (Human Factors Engineering)
10	SECURITY	SpecEng (Information Security Engineering)
11	SAFETY	SpecEng (Safety)
12	IN-SERVICE SUPPORT	LCE (Integrated Logistics Support; Sustainment/Technology Evolution)
13	VALIDATION (INCLUDES TEST AND EVALUATION) AND MASTER VERIFICATION PLAN	Validation and Verification (VV)
14	IMPLEMENTATION AND TRANSITION	LCE (Deployment and Transition; Disposal)
15	QUALITY ASSURANCE	SpecEng (Quality Engineering)
16	CONFIGURATION MANAGEMENT	Configuration Management (CM)
17	IN-SERVICE MANAGEMENT	LCE (Integrated Logistics Support (ILS); Sustainment/Technology Evolution))
18	SYSTEM ENGINEERING MANAGEMENT PLAN	ITP, FA, RM, SYN, TS, IA, RSK, IM, SpecEng,
19	INTEGRATED LIFECYCLE PLAN	Lifecycle Engineering
20	MASTER VERIFICATION PLAN	VV

The following describes which SE element is the source of information for each section of the IPP. The IPP summarizes the SE activities, while the SEMP and other supporting technical plans describe the implementation detail.

4.2.2.7.1 Background

Integrated Technical Planning is the source of information for summarizing the mission need and status of the program.

4.2.2.7.2 Overview

Integrated Technical Planning is the source of information about the scope of the program and the primary deliverables.

4.2.2.7.3 Integrated Program Funding

Integrated Technical Planning is the source for WBS, level of effort, and schedule/duration information in sufficient detail to allow cost estimators to identify funding requirements.

4.2.2.7.4 Integrated Program Schedule

Integrated Technical Planning is the source for WBS, milestone, and SE activity information to allow for a logical networking of program activities to achieve program objectives.

4.2.2.7.5 Performance

Within the "Core Work Activities" section, SE elements that are not specifically broken out as separate work activities are described here. SE elements such as Integrated Technical Planning, Functional Analysis, Synthesis, Trade Studies, Interface Management, Integrity of Analyses, and Specialty Engineering sub-elements, including Electromagnetic Environmental Effects and Reliability, Maintainability, and Availability, can be addressed to the extent that they apply.

Within the "Program Management Work Activities" section, specific SE elements such as Requirements Management, Specialty Engineering (System Safety), and Risk Management are identified as work activities requiring discussion. Program metrics are also described in this section, with Integrated Technical Planning as the source.

Within the "Procurement Work Activity" section, those SE resources required to support Screening Information Request (SIR) release, RFP development, proposal evaluations, and contractor requirements definition are identified.

4.2.2.7.6 Benefits

Requirements Management is the source for technical or performance benefits.

4.2.2.7.7 Physical Integration

SE inputs to this section of the IPP identify space, facility, environment, power, and hazardous materials activities that require planning.

4.2.2.7.8 Functional Integration

SE inputs to this section of the IPP include planning for function analysis to identify needed functions to perform system tasks and the development of a functional architecture.

4.2.2.7.9 Human Integration

SE inputs to this section of the IPP include the individual human factors engineering work tasks that must be done during implementation of the program. For each task, the IPP assigns the responsible person and organization, identifies any output and the approval authority, specifies when the task should be completed, and allocates resources.

4.2.2.7.9 Security

SE inputs to this section of the IPP include tasks to ensure that security is fully integrated into the system. It addresses the key information security tasks, including identification of security requirements, assessment of system alternatives and analysis of security risks, and evaluation of security features and controls for continuity of operations and disaster response to ensure appropriate availability.

4.2.2.7.10 Safety

SE inputs to this section of the IPP include tasks needed to ensure that safety is fully integrated into the system.

4.2.2.7.11 In-Service Support

The preliminary In-Service Decision activities of the deployment planning process focus on preparing for the In-Service Decision (ISD) meeting. The post In-Service Decision activities focus on documenting the In-Service Decision, establishing a periodic review, and tracking progress of completing the ISD Action Plan.

4.2.2.7.12 Verification

See the SEMP (Section 4.2.3) and MVP (Section 4.2.4) below.

4.2.2.7.13 Implementation and Transition

This section of the IPP includes all tasks to prepare for and assess the readiness of a solution to be implemented into the National Airspace System (NAS). Deployment planning tools (such as a tailored In-Service Review Checklist) shall be used to assist in identifying, documenting, and resolving deployment and implementation issues. Methods and techniques include, but are not limited to, a tailored application of generic tools; integration of checklist issues with other emerging issues (such as problem test reports from program tests and evaluation); development of action plans for resolution of checklist and other items; and documentation of the results of issue resolution and mitigation. Consistent deployment planning shall be visible in contractor "statement of work" and associated efforts.

4.2.2.7.14 Quality Assurance

The Quality Assurance (QA) planning section of the IPP includes developing high-level quality requirements, providing constraints for risk management, and identifying development and deployment metrics. The QA planning also includes support to contract activities by providing evaluation criteria, assisting in estimating cost, and evaluating proposals.

4.2.2.7.15 Configuration Management

This section of the IPP includes the CM tasks for ensuring that CM is performed both at the system level and the NAS level.

4.2.2.7.16 In-Service Management

This section of the IPP includes maintenance, staffing, supply support, support equipment, computer resources, training, and required personnel skills.

4.2.3 System Engineering Management Plan

The SEMP is the only implementing document that integrates all SE activities.

4.2.3.1 Introduction to the System Engineering Management Plan

The SEMP unambiguously ties together the organization, direction, and control mechanisms as well as personnel to be used to attain program/project cost, performance, and schedule objectives. This tool identifies and ensures control of the overall SE process and provides greater SE implementation detail than the IPP. The preliminary issue of the SEMP typically occurs in the first phase of Investment Analysis, with a final version released for JRC 2b. A scheduled update occurs in System Implementation, with additional updates issued as necessary to reflect changing input conditions throughout the program/project.

4.2.3.2 Inputs to System Engineering Management Plan

The SEMP relates the technical requirements to program requirements, providing the structure to guide and control integration of engineering activities to achieve the SE objectives consistent with a top-level management plan for the program. The SEMP includes more detailed planning for all SE elements to be executed as part of the program. Organizing to execute the system development involves defining the entire organizational structure (such as teams, work groups, and programs); establishing the responsibilities, authority, and accountability of each; and clearly defining structural interfaces. It is recommended that this be an iterative process.

Information and data needed to begin creating a SEMP include:

- Knowledge of corporate strategy and goals
- Description and understanding of the overall program/project, usually in an IPP or draft IPP
- Identification of top-level program/project requirements, usually taken from the MNS, final Requirements Document (fRD), change request, or one of the outputs developed during Mission Analysis Structure of engineering and other organizations, both internal (e.g., stakeholder) and external (e.g., supplier)
- Contract documents
- Any issues or constraints

4.2.3.3 System Engineering Management Plan Steps

The following steps shall be used to write a SEMP.

4.2.3.3.1 Step 1: Collect Inputs

All program elements, both technical and nontechnical, are responsible for providing SEMP inputs. Inputs are also gathered from the IPP, RFP, SOW, WBS, Cortland schedule information.

4.2.3.3.2 Step 2: Analyze Inputs

To determine the SE effort required and committed to by program management, review the IPP, which is based on the nature and magnitude of the program/project. For example:

- Large and complex system developments demand full System Engineering application to ensure success
- Small-scale projects may be run under a subset process
- SE shall coordinate with IPT teams and program management, as their concurrence ensures that the project team shall refer to and comply with the SEMP

4.2.3.3.3 Step 3: Define Activities and Efforts

After evaluating all inputs, establish how to integrate activities. Decisions that should be made involve:

- Tailoring the SE process
- Selecting an approach to ensure integration of engineering specialties
- How program team members will interact and communicate to execute technical program planning and control
- Identifying the explicit SE responsibilities to be assigned, accounting for all planned tasks
- The structure of the comprehensive SE Master Schedule (integrated with the IPP) for scheduled tasks
- Explicit guidance regarding development of each task for optimal inclusion, as program team members use the SEMP as a handbook and reference source for essential information

4.2.3.3.4 Step 4: Baseline

Prepare a draft SEMP for review and comment, using input from all affected engineering, engineering specialty, and program/project management organizations and, when appropriate, the stakeholders. The draft may also include contractual SEMP requirements, such as a CDRL Item and/or Data Item Description, with which all affected parties shall comply.

4.2.3.3.5 Step 5: Interface With Other Processes/Plans

In addition to employing the IPP as an input during development, the SEMP interfaces with and forms a roadmap to other SE and engineering specialty plans (e.g., Master Verification Plan). The SEMP addresses all SE elements:

- Integrated Technical Planning (Section 4.2)
- Requirements Management (Section 4.3)
- Functional Analysis (Section 4.4)
- Synthesis (Section 4.5)
- Trade Studies (Section 4.6)
- Interface Management (Section 4.7)
- Specialty Engineering (Section 4.8)
- Integrity of Analyses (Section 4.9)
- Risk Management (Section 4.10)

- Configuration Management (Section 4.11)
- Validation and Verification (Section 4.12)
- Lifecycle Engineering (Section 4.13)
- System Engineering Process Management (Section 4.14)

4.2.3.3.6 Step 6: Update and Maintain the Plan

It is recommended that throughout the program/project, the SE manager monitor inputs (especially the IPP) and, when there is a significant change in one or more inputs, revise the SEMP (by repeating the creation steps above).

4.2.3.4 Output of System Engineering Management Plan

Table 4.2-3 is a SEMP outline.

Table 4.2-3. System Engineering Management Plan Outline

System Engineering Management Plan Outline	
SECTION 1	INTRODUCTION
1.1	Scope
1.2	Purpose of the System Engineering Management Plan
1.3	Organization of the System Engineering Management Plan
1.4	SEMP Overview
1.5	Program/Project Name and System Description
1.6	Program Organization
1.7	System Engineering Responsibility Assignments
1.8	System Engineering Environment and Tools
1.9	System Engineering Metrics
SECTION 2	SYSTEM ENGINEERING
2.1	System Engineering Process
2.2	Integrated Technical Planning
2.3	Requirements Management
2.4	Functional Analysis
2.5	Synthesis
2.6	Trade Studies
2.7	Interface Management (may refer to IPP Section 7)
2.8	Specialty Engineering
2.8.1	System Safety Engineering
2.8.2	Human Factors Engineering (may refer to IPP Section 9)

System Engineering Management Plan Outline	
2.8.3	Quality Engineering (may refer to IPP Section 14)
2.8.4	Reliability, Maintainability and Availability
2.8.5	Electromagnetic Environmental Effects
2.8.6	Hazardous Materials Management/Environmental Engineering
2.9	Integrity of Analysis
2.10	Risk Management
2.11	Configuration Management (may refer to IPP Section 15)
2.12	Validation and Verification (may refer to IPP Section 12)
2.13	Lifecycle Engineering
2.13.1	Real Property Management
2.13.2	Deployment and Transition
2.13.3	Integrated Logistics Support
2.13.3.1	Maintenance Planning
2.13.3.2	Maintenance Support Facility
2.13.3.3	Direct-Work Maintenance Staffing
2.13.3.4	Supply Support
2.13.3.5	Support Equipment
2.13.3.6	Training, Training Support, and Personnel Skills
2.13.3.7	Technical Data
2.13.3.8	Packaging, Handling, Storage, and Transportation
2.13.3.9	Computer Resources Support
2.13.4	Sustainment/Technology Evolution
2.13.5	Disposal
2.14	System Engineering Process Management
SECTION 3	
3.1	System Engineering Master Schedule

Appendix E contains detailed input and format information for the planning associated with all of the SE elements discussed in Section 2 of the SEMP (as in the outline above.)

4.2.4 Master Verification Plan—See Appendix E for Details

The MVP contains both validation and verification planning (see Section 4.12, Validation and Verification, for definitions of these terms.) as well as test and evaluation planning This planning includes all the activities to ensure the right system is being built and to confirm that evolving system solutions comply with functional, performance, and design requirements, as well as performance and characteristics of the delivered system. Validation activities predominate in the early phases of the lifecycle, while verification activities dominate in the later phases. The MVP objective is to define all validation and verification activities that demonstrate the system's capability.

4.2.5 Integrated Lifecycle Planning

The Integrated Lifecycle Plan describes the tasks to perform lifecycle activities. It provides the content and depth of detail necessary for full visibility of all lifecycle activities. Each major activity is defined and described in detail. The plan provides a general schedule and sequence of events. The plan includes the following planning sections: integrated logistics, deployment and transition, sustainment and technology evolution, and disposal, The integrated logistics planning section includes these subsections: maintenance; maintenance support facilities; direct-work maintenance staffing; supply support; support equipment; training, training support, and personnel skills technical data; packaging, handling, storage, and transportation; and computer resources support.

4.2.5.1 Integrated Logistics Support

The planning section for integrated logistics support will include maintenance; the maintenance support facility; direct-work maintenance staffing; supply support; support equipment; training, training support, and personnel skills; technical data; packaging, handling, storage, and transportation; and computer resources support.

4.2.5.2 Deployment and Transition

See section 4.2.2.7.13.

4.2.5.3 Real Property Management

Include in the real property management planning section resources to determine if real property is required, acquisition costs, and acquisition strategy (buy or lease); also include real property into the Real Estate Management System and any participation in the real property inventory process.

4.2.5.4 Sustainment/Technology Evolution

The sustainment/technology planning section shall include tracking and evaluating RMA performance and supportability issues; analyzing supportability issues caused by market-driven products; system or subsystem obsolescence; determining the most cost-effective means of avoiding projected supportability shortfalls; assessing integration of obsolescence-driven system changes with new requirements; evaluating the impact of engineering changes, performance shortfalls, or technological opportunities on integrated logistics support products and support services; and support for revalidation or development of MNSs.

4.2.5.5 Disposal

The disposal planning section shall include all activities associated with disposal management; dismantling/demolition/removal; restoration; degaussing or destruction of storage media; and salvaging of decommissioned equipment, systems, or sites. The systems, components, assemblies, and other components that will be removed, disposed of, or cannibalized must be identified, as well as the agent responsible for disposal. Include in the planning an assessment of the system to determine the need to scavenge usable parts/subsystems from facilities to be decommissioned. (This is particularly important for items that are no longer being manufactured.) Also include in the planning an evaluation of environmental issues (including any hazardous materials), determination of disposition location, and removal of the system from the operational inventory.

4.2.5.6 Integrate Lifecycle Plan (ILP)

Table 4.2-4 is the ILP outline.

Table 4.2-4. Integrated Lifecycle Plan Outline

Integrated Lifecycle Outline	
SECTION 1	INTRODUCTION
1.1	Scope
1.2	Purpose of the Integrated Lifecycle Plan
1.3	Organization of the Integrated Lifecycle Plan
1.4	ILP Overview
1.5	Program/Project Name and System Description
1.6	Program Organization
1.7	Integrated Lifecycle Responsibility Assignments
1.8	Integrated Lifecycle Environment and Tools
1.9	Integrated Lifecycle Metrics
SECTION 2	Integrated Lifecycle Engineering
2.1	ILS
2.1.1	Real Property Management
2.1.2	Deployment and Transition
2.1.3	Integrated Logistics Support
2.1.3.1	Maintenance Planning
2.1.3.2	Maintenance Support Facility
2.1.3.3	Direct-Work Maintenance Staffing
2.1.3.4	Supply Support
2.1.3.5	Support Equipment
2.1.3.6	Training, Training Support, and Personnel Skills
2.1.3.7	Technical Data
2.1.3.8	Packaging, Handling, Storage, and Transportation (P,H,S&T)
2.1.3.9	Computer Resources Support
2.1.4	Sustainment/Technology Evolution
2.1.5	Disposal
SECTION 3	
3.1	Integrated Lifecycle Master Schedule

4.2.6 Technical Reviews and Audits

Technical reviews and audits are used to establish the readiness of a program to proceed to the next phase of development. Reviews and audits are scheduled at strategic points within the development cycle and are usually conducted in conjunction with, or in preparation for, a lifecycle phase milestone at which the decision to advance to the next phase is made. Technical reviews employ specific criteria tailored to each phase of the lifecycle. These criteria verify the extent of technical progress made toward solution of the identified capabilities shortfall.

Certain reviews and audits directly support a phase exit decision point. Others provide interim benchmarks on the progress and maturity of the effort associated with the given phase. The reviews and audits in this section are grouped by the AMS phase and decision points they support. Each technical review/audit shown in Table 4.2. -5 is described in detail along with its objectives and scope related to the lifecycle phase it is supporting. For the purposes of this SEM, the AMS lifecycle phases and their related reviews/audits are shown in the table.

Table 4.2-5. Technical Reviews/Audits as a Function of AMS Lifecycle Phases

Lifecycle Phase	Technical Review/Audit	Type	Decision Point
Mission Analysis	Mission Analysis Progress Review	Interim	
	Investment Analysis Readiness Review	Entry Criteria	Mission Need Decision (JRC 1)
Investment Analysis	Preliminary Solution Review*	Entry Criteria	Solution Selection Decision (JRC 2a)
	Critical Solution Review*	Entry Criteria	Investment Decision (JRC 2b)
Solution Implementation	System Requirements Review	Interim	
	Preliminary Design Review	Interim	
	Critical Design Review	Interim	
	Functional Configuration Audit	Interim	
	Physical Configuration Audit	Entry Criteria	In-Service Decision
In Service	Service Viability Review	Entry Criteria	Mission Analysis Initiation Decision

- These reviews might be informal or internal to the investment analysis team.

4.2.6.1 Technical Reviews

Technical reviews are used in development programs to assess the maturity of the product or service under consideration. While specific reviews are identified in the following subsections, additional reviews can be added based on the specific needs of the program. The reviews are scheduled at strategic points within the development cycle. Technical reviews employ specific criteria tailored to each phase of the development. These criteria verify the extent of technical progress made toward the solution of the identified capabilities shortfall.

In the Mission Analysis and Investment Analysis phases, the goal is to ensure that the definitions of the need and its derived operational requirements are complete and accurate and that all necessary design constraints have been identified. In the Solution Implementation phase, the goal is to monitor the technical progress of the development to ensure that it remains consistent with the established operational requirements and design constraints. The goal is also to assist program management in assessing the maturity of the design in order to identify risks and form the basis for determining overall progress in the program. In each case, a well-structured technical review will include defined entry criteria (inputs for conducting a successful review); a basic set of common steps for every review; a predefined set of outcomes expressed as exit criteria; and a set of metrics to measure success. This construct is illustrated in Figure 4.2-2.

Process:

Perform Technical Review

ID No.: 4.2.6.1 (iCMM PA 21, 22, 23)

Date: July 23, 2004

Revision Date: September 30, 2004

Next Higher Level Process:

Perform Integrated Technical Planning

Process Owner:

System Engineering Council

Process Objective:

Verify that the system being developed is consistent with requirements.

Inputs

a) Previously completed products/documents with proposed changes
b) Draft products and documents (Requirements Documents, Architectures, TPPs & criteria, Risk Management Plans, etc.)
c) Reports (Functional Analysis, TPM, Risk Management, Test, etc.)

Providers

a) ITP, RM, FA, SpecEng, RSK, TS, Syn, IM
b) RM, FA, SpecEng, RSK, TS, Syn, IM
c) FA, SpecEng, V&V, RSK

PROCESS TASKS

Beginning Boundary Task

Define review objectives and scope.

- Identify item(s) to be reviewed
- Compile & distribute review data package
- Obtain participant response to data package.
- Update data package.
- Conduct the Review
- Document the Review
- Track action items and issues.

Ending Boundary Task

Document closed action items & issues.

Lifecycle Phase

- ☑ Mission Analysis
- ☑ Investment Analysis
- ☑ Solution Implementation
- ☑ In-Service Mgmt
- ☐ Service Life Ext.
- ☐ Disposal

Outputs

a) Approved design documents. (MNS, iRD/fRD, specifications, architectures, etc.)
b) Updated plans (Risk Management Plans, test plans, TPM plan, etc.)
c) Approved reports. (Test, TPM, Risk Management, Review Minutes, etc.)

Customers

a) EXT, RM, CM, FA, Syn, IM, V&V
b) EXT, RSK, V&V, SpecEng
c) EXT

Figure 4.2-2. Technical Review Process

While each type of technical review is described in detail in subsequent paragraphs, all technical reviews exhibit the same characteristics at a rudimentary level, as shown in Figure 4.2-2. These characteristics are as follows:

Entrance Criteria (Inputs). Inputs to a review depend on the nature of the review and the point within the development cycle at which the review occurs. Accordingly, the primary inputs to a review consist of new products that have been generated since the previous review that reflect advancement of development toward completion. In addition, inputs will include products and documents that were completed in previous development phases, along with any proposed changes, to ensure that the information they contain is adequate and appropriate to proceed to the next phase. Once technical performance parameters (TPPs) have been established for a program, the status of these TPPs will be included as inputs to enable measurement and tracking of the maturity of the design and risks to meeting the requirements. Each review must consider the constraints under which the system is being developed and the risks and associated mitigation plans defined in previous stages. Typical inputs to reviews include:

- Previously completed documents and products

  – Technical planning documents (used to define the scope, objectives, and timing of the review).

  – Mission Need Statements.

  – Requirements documents and specifications, including Interface Requirements Documents (IRD) and Interface Control Documents (ICD) Architectures

  – List of allocated TPPs and associated critical performance limits and target values

  – Constraints

  – Risk Management Plans

  – Test plans

  – Proposed changes to previously completed documents and products.

- Draft products and documents.

  – Mission Need Statements.

  – Requirements documents and specifications, including IRDs and ICD.

  – List of allocated TPPs and associated critical performance limits and target values

  – Constraints

  – Risk Management Plans

- Reports

  – Functional Analyses

  - Technical Performance Measurement (TPM) reports
  - Test, evaluation, verification, and validation reports
  - Risk management reports

Process. A prerequisite for conducting a review is the approval of technical planning documentation that defines the objectives and scope of the review; entry criteria and items to be reviewed; the schedule coordinated with the overall program schedule; the general approach for the accomplishing the review; and review participants. The objectives of the review should be defined in terms of success criteria or outcomes. The approach can range from an informal review for small programs to incremental reviews for large complex programs. An example of a defined approach for a Critical Design Review (CDR) would be conducting design assessments on lower-level design elements on an incremental basis leading to a CDR that integrates the results of the individual lower-level reviews. Once the objectives and scope are established, the data to support these objectives can be identified. While the schedule in the technical planning documentation provides guidance for setting the review date, the specific review date is set once the entry criteria are determined to be in place.

The generic steps for conducting a review are:

- Define review objectives and scope
  - Establish success criteria and prerequisites (entry criteria and approach to be used)
  - Set review date and activities leading up to the review
  - Create an agenda for the review
  - Identify and notify participants and stakeholders of their roles and responsibilities
- Identify the item(s) to be reviewed and the extent of review of each
- Compile and distribute review data package
- Obtain participant response to data package
  - Assessment of readiness to proceed.
  - Comments to the data package (Review Item Discrepancies)
- Update data package
  - Incorporate accepted changes
  - Provide summary of concerns.
  - Update Risk Management Plans.
- Conduct review

- Document the review
  - Publish review minutes
  - Compile action-item list
  - Compile issues list
- Track action items and issues
- Document closed action items and issues

Exit Criteria (Outputs). Outputs are the outcome of a successful technical review. They comprise a set of records that may be used to support a critical decision point or to verify that another key phase in the development has been reached. They contain approved documents or approved changes to documents under review, and may result in adding documents to the baseline. Typical review outputs include:

- Approved design documents.
  - MNS
  - Initial Requirements Document iRD/Final Requirements Document (fRD)
  - Specifications
  - IRD/ICD
  - Architectures
  - Technical manuals
- Updated plans
  - Risk management plans
  - Test plans
  - TPM plans
- Approved reports
  - Test reports
  - TPM reports
  - Risk Management Reports
  - Review Minutes
  - Action item and issue documentation

Tools. The tools used to conduct technical reviews record the changes to and status of the technical baseline as the development proceeds. They include the requirements database, the technical performance measurement database, the risk database, and the database used to document and monitor action items and issues.

Metrics. Metrics are preestablished criteria that measure the success of a technical review that, in turn, allows the project to proceed to the next phase. They usually include:

- Customer (stakeholder) acclamation, which is defined as the extent of satisfaction that the review met the stated objectives. This can be measured through customer feedback surveys or formal concurrence with the final review data package.

- The number of new system or subsystem requirements that surfaces at later reviews compared to the original number of requirements

- The number of RFAs that are resolved by formal action

- Errata measured as the number of pages changed as a percentage of the total page count of the presentations

Individual technical reviews, due to its particular characteristics, may have additional, specific metrics.

As an aid in assessing progress throughout a development program, a process called Technical Performance Measurement (TPM) is employed. TPM provides a quantitative means to pinpoint emerging design deficiencies, monitor progress relative to satisfying requirements, and developing trend information to assess program risks. TPPs are established during the Investment Analysis phase. These TPPs are critical technical performance requirements that support critical operational needs and essentially measure the extent of success or failure of a design to meet those needs. The critical requirements are either selected or derived from the performance requirements included in the IRD. These TPPs are revised and refined when the fRD is finalized and could be further expanded or refined as the specific solution takes shape.

In selecting a TPP, a critical performance value or limit is identified. This represents the absolute limit for the final as-built design. For the purposes of minimizing technical risk associated with the TPP, a target performance value is established that is within the critical performance limit and that provides a contingency or reserve to cover unexpected design problems and changes. The values of the parameter between this target value and the critical limit can be divided into ranges with different associated risk levels. As the design progresses, the value of the TPP at completion is projected based on the current state of the design. As the design approaches completion and realization, the projected value of the TPP will converge to the final as-built design value. Accurate projections of the TPP along with trend analysis will help identify risks and provide opportunities to mitigate those risks more efficiently and effectively.

Before each technical review, an analysis is performed for each TPP to determine the changes in projected value from the previous analysis and to document the status of the TPP. The results of these analyses are included in the design data reviewed prior to the technical review. Stakeholders will review the assumptions, processes and raw data used in the analyses to verify the validity of the results. Once validated, the results will be assessed to identify any risks

or action items that need to be presented at the technical review. Issues concerning the validation of the results are worked off before the technical review.

4.2.6.1.1 Mission Analysis Phase

Per the FAA AMS, Mission Analysis is the critical beginning phase of the lifecycle management process. It establishes the basis for long-range strategic planning by individual service organizations and the FAA as a whole, and it identifies, defines, evaluates, and prioritizes alternative options for improving service delivery. Mission Analysis consists of corporate-level mission analysis, service area analysis, and concept and requirements definitions. Research projects often support and provide information to mission analysis.

4.2.6.1.1.1 Mission Analysis Progress Review (MAPR)

The MAPR is essentially a midpoint check to determine if the mission analysis effort is progressing satisfactorily toward a recommendation. This review might be informal and/or internal to the organization(s) performing the mission analysis. The outcome of this review is a decision on whether the analysis is achieving the desired progress toward an Investment Analysis Readiness Review (IARR), or there is sufficient risk to consider termination or rescoping the specific analysis. The decision criteria to be used as part of this review include:

- Draft Mission Need Statement
- Quantified shortfall analysis
- Range of Alternative solutions
- Architecture Outlook
- Action Plan for IARR

4.2.6.1.1.2 Investment Analysis Readiness Review

The intent of the IAAR) is to find out whether the documentation of the mission need, capabilities shortfall, candidate solutions (concepts and general technical capabilities), technical constraints, and risks is complete enough to support a Mission Need Decision. This checkpoint verifies that the identified needs, shortfalls, and technical constraints have been validated; that initial feasibility assessments have been accomplished; and that proposed solutions are consistent with the NAS Architecture or that required changes to the NAS Architecture have been identified. The technical part of this review involves reviewing the iRD for readiness to proceed to investment analysis. The IARR also establishes an initial set of TPPs.

4.2.6.1.2 Investment Analysis Phase

Per the FAA AMS, the Investment Analysis phase of the Acquisition lifecycle is conducted to ensure that the critical needs of the FAA are satisfied by practical and affordable solutions. Initial investment analysis rigorously evaluates alternative solutions to mission need and determines which offers the best value and most benefit to the FAA and its customers within acceptable cost and risk. Final investment analysis develops detailed plans and final requirements for the proposed investment program, including an acquisition program baseline

that establishes cost, schedule, performance, benefits, and risk-management boundaries for program execution.

4.2.6.1.2.1 Preliminary Solution Review (PSR)

The PSR may be informal and/or internal to the investment analysis team. It reviews the trade study reports on candidate solutions and approves the recommendation of one or more candidate solutions for investment analysis. It also reviews and approves the updated iRD tailored to the recommended solutions. The outcome of this review is readiness to proceed to an Initial Investment Decision (JRC 2a).

4.2.6.1.2.2 Critical Solution Review

The CSR may be informal and/or internal to the investment analysis team. It reviews the trade study reports on candidate solutions and approves the recommendation of one or more candidate solutions for investment analysis. It reviews and approves the fRD, final TPPs, and the revalidation of the Mission Need Statement tailored to the recommended solutions. The outcome of this review is a determination that the recommended solution represented by a proposed Acquisition Program Baseline (APB) is complete enough to proceed to an Investment Decision (JRC 2b).

4.2.6.1.3 Solution Implementation Phase

The Solution Implementation Phase of the AMS begins at the final investment decision when the JRC approves and funds an investment program, establishes its APB for variance tracking, and authorizes the service organization to proceed with full implementation. Solution implementation ends when a new service or capability is commissioned into operational use.

4.2.6.1.3.1 System Requirements Review (SRR)

The purpose of the SRR is to determine that the System Requirements Document (Type A Specification) correctly and completely represents the operational and constraint requirements defined in the fRD. This review also determines if the proposed functional architecture is consistent with the system requirements. This review occurs early in the development process before expenditure of any extensive design definition. As part of the process of determining whether the system requirements and architecture capture the missions needs, values for all TPPs are projected based on system requirements and compared to the target values and critical limits set during investment analysis. The results of the TPM analysis become part of the output of the SRR. Additional TPPs might be added depending on requirements changes approved at the SRR. Critical performance limits might also be adjusted based on approved requirements changes.

4.2.6.1.3.1.1 Entrance Criteria (Inputs)

Previously completed products required before proceeding to SRR include:

- iRD/fRD
- List of allocated TPPs and associated critical performance limits and target values
- Constraints

- IRDs
- Risk identification and risk mitigation plans
- Any proposed changes to the above items as a result of the work leading up to the SRR

Products that are to be submitted for review as part of the SRR include:

- System Requirements Document/Type A Specification (draft)
- System Functional Architecture (draft)
- A report on the results of the TPM analyses

4.2.6.1.3.1.2 Tasks

The following tasks are required to successfully accomplish the SRR:

- Define SRR objectives and scope
  - Establish success criteria and prerequisites (entry criteria and approach to be used)
  - Set the date for the SRR and activities leading up to the review
  - Create an agenda for the review
  - Identify and notify participants and stakeholders of their roles and responsibilities
- Identify the item(s) to be reviewed and the extent of review of each
- Compile the SRR- related data package. This package contains the SRR presentation material and all pertinent backup material.
- Distribute the SRR documentation to the stakeholder representatives and request timely review responses
- Obtain readiness approval for SRR and comments to the data package made via Review Item Discrepancy submissions
- Incorporate changes in the data package as needed
- Develop a summary of all concerns submitted and their respective answers
- Update risk-management plans based on review
- Conduct SRR with the incorporated changes
- Document and publish SRR minutes
- Compile action-item and issues lists

- Track action items and issues
- Document closed action items and distribute to the SRR stakeholders

4.2.6.1.3.1.3 Exit Criteria (Outputs)

The outputs include:

- Approved System Requirements Document/Type A Specification
- Approved System Functional Architecture
- Approved changes to the fRD
- Approved changes to the IRDs
- Approved changes to the TPPs
- Approved TPM report
- Updated Risk Management Plans

4.2.6.1.3.1.4 Metrics

The metrics for this review consist primarily of the following:

- Customer acclamation
- Number of system requirements that surface at later reviews compared to the original number of requirements
- Errata

If prototyping has been done to assist in finalizing the system requirements, then it is possible to measure changes in the status of the TPPs. Otherwise, TPM is not be part of the metrics for this review.

4.2.6.1.3.1.5 Tools

The primary tools used for this review are:

- Requirements Database
- Risk Database
- Action Item Database
- Issues Database
- TPM Database (if used as a metric)

4.2.6.1.3.2 Preliminary Design Review (PDR)

The PDR describes the system functions allocated to the subsystem and configuration item level. The solution design definition lacks considerable detail and is represented by the functional, performance, and interface requirements included in the Type B and Type C Specifications, and the draft ICDs. The PDR demonstrates that the preliminary design meets system and program requirements as specified in the fRD and the Type A Specification previously approved. As part of the process of determining whether the design meets requirements, values for all Technical Performance Parameters (TPPs) allocated to the design are projected and compared to the target values and critical limits set during investment analysis. The results of the Technical Performance Measurement (TPM) analysis become part of the output of the PDR. Additional TPPs might be added depending on design or requirements changes approved at the PDR. Critical performance limits might also be adjusted based on approved requirements changes.

4.2.6.1.3.2.1 Entrance Criteria (Inputs)

Previously completed products required before proceeding to PDR include:

- fRD
- List of allocated TPPs and associated critical performance limits and target values
- Constraints
- Type A Specification
- Functional Architecture
- IRDs
- Risk identification and mitigation plans
- Any proposed changes to the above items as a result of the work leading up to the PDR

Products that are to be submitted for review as part of the PDR include:

- Type B Specification (draft)
- Type C Specification, if needed (draft)
- Requirements Allocation Matrix (draft)
- ICDs (draft)
- A report on the results of the TPM analyses
- Preliminary design documentation (conceptual layouts, etc.)

4.2.6.1.3.2.2 Tasks

The following tasks are required to successfully accomplish the PDR:

- Define PDR objectives and scope
  - Establish success criteria and prerequisites (entry criteria and approach to be used)
  - Set the date for the PDR and activities leading up to the review
  - Create an agenda for the review
  - Identify and notify participants and stakeholders of their roles and responsibilities.
- Identify the item(s) to be reviewed and the extent of review of each
- Compile the PDR-related data package. This package contains the PDR presentation material and all pertinent backup material.
- Distribute the PDR documentation to the stakeholder representatives and request timely review responses
- Obtain readiness approval for PDR and comments to the data package made via Review Item Discrepancy (RID) submissions
- Incorporate changes in the data package as needed
- Develop a summary of all concerns submitted and their respective answers
- Update risk-management plans based on review
- Conduct PDR with the incorporated changes
- Document and publish PDR minutes
- Compile action-item and issues lists
- Track action items and issues
- Document closed action items and distribute to the PDR stakeholders.

4.2.6.1.3.2.3 Exit Criteria (Outputs)

- Approved allocated baseline
  - Preliminary Type B Specification
  - Preliminary Type C Specification
  - Preliminary Requirements Allocation Matrix

  - Preliminary ICDs

- Approved changes to the fRD
- Approved changes to the Type A Specification
- Approved changes to the Functional Architecture
- Approved changes to the IRDs
- Approved changes to TPPs
- Approved TPM report
- Updated Risk Management Plans

4.2.6.1.3.2.4 Metrics

The PDR metrics are:

- Customer acclamation
- The number of new subsystem requirements that surfaces at later reviews or testing compared to the initial number of requirements
- The number of design features that change, compared to the original number, as a result of inadequate analysis prior to the PDR

The status of the TPPs will also be used as a metric to measure the progress of the program.

4.2.6.1.3.2.5 Tools

The primary tools used for this review are:

- Requirements Database
- Risk Database
- Action Item Database
- Issues Database
- TPM Database

4.2.6.1.3.3 Critical Design Review (CDR)

The CDR is conducted to describe the design of a system or configuration item (CI) down to the lowest design level. It is conducted during the design and development phase of a program when detail design is essentially complete. The purpose is to:

- Determine that the detail design of the system or configuration item under review satisfies the performance and engineering specialty requirements of the Preliminary Hardware Product Specifications or Hardware Configuration Item development specifications. This includes projecting values for all TPPs allocated to the design and comparing them to the target values and critical limits set during Investment Analysis. The results of the TPM analysis become part of the output of the CDR.

- Establish the detail design compatibility among the configuration items and other items of equipment, facilities, computer software, and personnel

- Assess system or CI risk areas (on a technical, cost, and schedule basis)

- Assess the results of the producibility analyses conducted on system hardware

- Review the preliminary hardware product specifications. For Computer Software Configuration Items, this review will focus on determining the acceptability of the detailed design, performance, and test characteristics of the design solution and on the adequacy of the operation and support documents.

4.2.6.1.3.3.1 Inputs

The CDR entrance criteria are:

Previously completed products required before proceeding to CDR, including:

- fRD

- List of allocated TPPs and associated critical performance limits and target values

- Constraints

- Type A Specification

- Functional Architecture

- IRDs

- Master Verification Plan

- Risk identification and mitigation plans

- Any proposed changes to the above items as a result of the work leading up to the CDR.

Products that are to be submitted for review as part of the CDR include:

- Detailed Type B Specification

- Detailed Type C Specification

- Detailed Requirements Allocation Matrix

- Detailed ICDs
- Design documentation (assembly layouts, etc)
- Draft test plans
- Complete Design Analysis
- Subsystem Functional Architecture
- Report on results of the TPM analyses

4.2.6.1.3.3.2 Tasks

The following tasks are required to accomplish a successful CDR:

- Define CDR objectives and scope.
  - Establish success criteria and prerequisites (entry criteria and approach to be used)
  - Set the date for the CDR and activities leading up to the review
  - Create an agenda for the review
  - Identify and notify participants and stakeholders of their roles and responsibilities
  - Identify the item(s) to be reviewed and the extent of review of each
- Compile the CDR-related data package. This package contains the CDR presentation material and all of the pertinent backup material
- Distribute the CDR documentation to the stakeholders and request timely review responses
- Obtain readiness approval for CDR and comments to the data package made via RID submissions
- Incorporate changes in the data package as needed
- Develop a summary of all concerns submitted and their respective answers
- Update risk-management plans based on review
- Conduct CDR with the incorporated changes
- Document and publish CDR minutes
- Compile action-item and issues lists
- Track action items and issues

- Document closed action items and distribute to the CDR stakeholders

4.2.6.1.3.3.3 Outputs

The CDR outputs or exit criteria are:

- Customer concurrence that the detailed design satisfies the system functional and performance requirements
  - Approved Type B Specification
  - Approved Type C Specification
  - Approved Requirements Allocation Matrix
  - Approved ICDs
- Approved Test Plans
- Updated Master Verification Plan
- Approved changes to the fRD
- Approved changes to the Type A Specification
- Approved Physical Architecture
- Approved changes to the IRDs
- Approved changes to TPPs
- Approved TPM report
- Updated Risk Management Plans

4.2.6.1.3.3.4 Metrics

The CDR metrics are:

- Customer (Stakeholder) acclamation, which is defined as the extent of satisfaction in the results of the CDR meeting the stated objectives. This can be measured through interviews and/or feedback forms for each presentation made during each review (incremental as well as final).
- The percentage of CDR-required data available on schedule. In the case of a technical review involving a supplier, this can be measured as the percent of review related CDRLs submitted on schedule
- The number of new subsystem requirements that surfaces at later reviews or testing compared to the initial number of requirements

- The number of RFAs dispositioned for formal action
- Errata measured as the number of pages changed as a percent of the total page count of the presentations

The status of the TPPs will also be used as a metric to measure the progress of the program.

4.2.6.1.3.3.5 Tools

The primary tools used for this review are:

- Requirements Database
- Risk Database
- Action Item Database
- Issues Database
- TPM Database

4.2.6.1.4 In-Service Phase

The In-Service management phase begins when the new system, software, facility, or service goes into operational use and continues for as long as the product is in use. This phase is characterized by a continuing partnership among the providing, operating, and support organizations. During this period, service organizations should anticipate problems before they become unmanageable.

4.2.6.1.4.1 Service Viability Review (SVR)

The SVR might be informal and/or internal to the system or capability owner. The outcome of this review is a decision on whether a configuration item (or system) has reached the end of its useful life, or is no longer satisfying an identified need. The outcome may span a range of recommendations—from a strategy of continued support of the installed capability (see Section 4.13, Lifecycle Engineering, for further discussion of this outcome) to a decision to make obsolete the existing system and enter the Mission Analysis phase to address the resulting predicted need shortfall.

4.2.6.2 Audits

Audits are used to verify that the system that has been developed is consistent with the requirements baseline. Audits are conducted in two phases. The Functional Configuration Audit (FCA) phase uses testing to verify that the system functions and performs according to the specifications. The testing is done at the configuration item level. The Physical Configuration Audit (PCA) verifies the completion of any corrective actions identified through the FCA as well as verifies that all baseline documentation is complete and accurately represents the as-built system.

In each case, an audit plan should be prepared to accomplish the following:

- Detail the audit processes to be used
- Identify the participants and their responsibilities
- Identify the item(s) to be audited
- Document the audit schedule
- Identify the documentation and supporting reference material to be audited
- Identify any supporting activities
- Furnish examples of PCA-related documentation, as appropriate

4.2.6.2.1 Functional Configuration Audit

The FCA documents the approval by stakeholders of verification that a CI's actual performance fulfills the functional and performance requirements established in the system baseline. An FCA is held for each new configuration item or group of related configuration items. An FCA can also be held during the In-Service phase of a system's lifecycle to verify modifications and upgrades to a configuration item, or product and process improvements. The entry and exit criteria for this audit and any other pertinent accomplishment and associated success criteria are to be included in the SEMP. An FCA is an incremental part of the system verification process. System changes that involve multiple configuration items may require multiple audits. A final audit, or system verification review, is held to verify that all planned audits for a particular development have been successfully completed. Since the FCA relies on testing to determine if the CI meets all specified requirements, such testing is a prerequisite for the FCA. The process-based management chart for the FCA appears in Figure 4.2-3.

Process:

Perform Functional Configuration Audit

ID No.: 4.2.6.2 (iCMM PA 21, 22, 23)
Date: July 23, 2004
Revision Date: September 30, 2004

Next Higher Level Process:
Perform Integrated Technical Planning

Process Owner:
System Engineering Council

Process Objective:
Verify that the system being developed is consistent with requirements.

Inputs

a) Identification of CI to be audited
b) Update design documentation
c) Test plans and procedures
d) Test results
e) Test waivers
f) Action item documentation
g) Shortage list
h) Updated risk management plans

Providers

a) EXT
b) RM, Syn, IM, CM
c) ITP, V&V
d) V&V
e) V&V, EXT
f) EXT
g) EXT
h) RSK

PROCESS TASKS

Beginning Boundary Task
Define review objectives and scope.

- Identify item(s) to be audited
- Create agenda
- Identify, notify, and instruct participants
- Collect data package inputs
- Distribute audit documentation for review
- Obtain comments and readiness approval
- Update audit documentation
- Conduct audit
- Document and distribute results

Ending Boundary Task
Document and distribute resolutions.

Lifecycle Phase

- ☐ Mission Analysis
- ☐ Investment Analysis
- ☑ Solution Implementation
- ☐ In-Service Management
- ☐ Service Life Ext.
- ☐ Disposal

Outputs

a) All requirements verified
b) All design documentation complete

Customers

a) CM, EXT, ITP (PCA)

Figure 4.2-3. Functional Configuration Audit Process

Figure 4.2-3 Functional Configuration Audit Process

4.2.6.2.1.1 Inputs

Basic inputs to the FCA include:

- Identification of the CI to be audited
- Update of all specification and design documentation complete (Specification Types A, B, and C; Requirements Allocation Matrix; ICDs; System Concept of Operations (CONOPS); Subsystem Functional Architecture; Physical Architecture; and CI Description).
- All manufacturing process requirements and documentation finalized (Specification Types D and E)
- Test plans and procedures
- Test results
- A list of all deviations/waivers against the CI, either requested or customer approved
- A list of all action items for corrective action resulting from the test results
- Documentation of proposed corrective actions
- Complete shortage list
- Updated risk-management plans based on the test results

4.2.6.2.1.2 Tasks

The following tasks are required to successfully accomplish an FCA:

- Define FCA objectives and scope
  - Establish success criteria and prerequisites (entry criteria and approach to be used)
  - Set the date for the FCA and activities leading up to the audit
  - Create an agenda for the audit
  - Identify, notify and instruct participants and stakeholders concerning their roles and responsibilities
  - Identify the CI(s) to be audited and the extent of its review
- Collect data package inputs for FCA briefing and documentation

- Distribute FCA documentation to stakeholder representatives for review for completeness, correctness, clarity, and organization
- Obtain readiness approval for FCA and comments to the data package made via audit worksheets
- Update FCA documentation per the worksheets
- Conduct FCA
  - Report on verification status - requirements verified versus planned corrective actions
  - Report on completeness of all development and design documentation, including planned revisions associated with corrective actions
  - Report on key issues identified in the review of the FCA documentation
  - Report on risk assessments and mitigation plans
  - Assign responsibility for corrective actions and documentation revisions
  - Obtain stakeholder approval to proceed
- Document and distribute the results of the FCA
- Compile action-item and issues lists
- Track action items and issues
- Document and distribute the resolutions of action items and issues

4.2.6.2.1.3 Outputs

The key outputs of the FCA are:

- Verification that the system meets functional requirements
  - Type A Specification verified
- Completion of all CI verification tasks against requirements
  - Type B Specification verified
  - Type C Specification verified
  - Requirements Allocation Matrix verified
  - ICDs verified
- Completion of all development and design documentation

- Type B Specification
- Type C Specification
- Requirements Allocation Matrix
- ICDs
- System Level CONOPS
- OSED
- Functional Architecture
- Physical Architecture
- CI Description

4.2.6.2.1.4 Metrics

The metric is stakeholder approval of the FCA.

4.2.6.2.1.5 Tools

The primary tools used for this audit are:

- Requirements Database
- Action Item Database
- Issues Database

4.2.6.2.2 Physical Configuration Audit

The PCA establishes the baseline for formal configuration control of the CI for Production and later Lifecycle phases. The PCA documents the agreement of the stakeholders that the CI's actual configuration as built by the specified manufacturing processes conform to the Technical Data Package that describes the CI baseline. The audit also verifies that the processes for controlling changes to the Product Baseline are in place and functioning. PCA also marks the complete transfer of formal configuration control from the implementer to the product owner. A PCA is held for each new CI or group of related CIs. A PCA can also be held during the In-Service phase of a system's lifecycle to verify modifications and upgrades to a CI, or product and process improvements. The entry and exit criteria for this audit and any other pertinent accomplishment and associated success criteria are to be included in the SEMP. A PCA is an incremental part of the system verification process. System changes that involve multiple configuration items may require multiple audits. A final audit is held to verify that all planned audits for a particular development have been successfully completed. The process-based management chart for the PCA appears in Figure 4.2-4.

Process:

Perform Physical Configuration Audit

ID No.: 4.2.6.2.2 (iCMM PA 21, 22, 23)
Date: July 23, 2004
Revision Date: September 30, 2004

Next Higher Level Process:
Perform Integrated Technical Planning

Process Owner:
System Engineering Council

Process Objective:
Establishes the baseline for formal configuration control of the configuration.

Inputs

a) Identification of CI to be audited
b) Completion of IOT&E
c) Completion of changes resulting from IOT&E
d) All documentation updated
e) List of deviations/waivers
f) Action item documentation
g) Shortage list
h) Updated risk management plans

Providers

a) EXT
b) V&V
c) V&V
d) RM, Syn, IM, CM
e) V&V, EXT
f) EXT
g) EXT
h) RSK

PROCESS TASKS

Beginning Boundary Task
Define review objectives and scope.

- Conduct Kickoff meeting and team training
- Review FCA action item status
- Verify IOT&E required changes
- Collect data package inputs
- Distribute audit documentation for review
- Obtain comments and readiness approval
- Update audit documentation
- Conduct audit
- Document and distribute results
- Compile action item and issues lists
- Track action items and issues

Ending Boundary Task
Document and distribute resolutions.

Lifecycle Phase

- ☐ Mission Analysis
- ☐ Investment Analysis
- ☑ Solution Implementation
- ☐ In-Service Management
- ☐ Service Life Ext.
- ☐ Disposal

Outputs

a) Certification of requirements verification
b) Certification that design documentation baseline

Customers

a) CM, EXT

Figure 4.2-4. Figure Configuration Audit Process

4.2.6.2.2.1 Inputs

Basic inputs to the PCA include:

- List of the CI to be audited
- Report of Independent Operational Test and Evaluation (IOT&E) and identification of required changes
- Updated list of all required changes identified through the IOT&E
- Updated list of all specification and design documentation complete (Specification Types A, B, and C; Requirements Allocation Matrix; ICDs; System CONOPS; Subsystem Functional Architecture; Physical Architecture, and CI Description)
- Updated list of all manufacturing process requirements and documentation finalized (Specification Types D and E)
- List of all deviations/waivers against the CI, either requested or customer-approved.
- Complete shortage list
- Updated risk-management plans based on the audit results

4.2.6.2.2.2 Tasks

These tasks are required to successfully accomplish a PCA:

- Define the objectives and scope of the PCA
  - Establish success criteria, pre-requisites (entry criteria, and approach to be used).
  - Set the date(s) for the PCA and activities leading up to the audit
  - Create an agenda for the audit
  - Identify and notify participants and stakeholders of their roles and responsibilities
  - Identify the CI(s) to be audited and the extent of review of each
- Review status of action items from the FCA to determine if they have been adequately resolved; identify any corrective action required
- Verify that all changes identified through the IOT&E have been incorporated; identify any corrective action required. Reconcile all proposed and actual configuration differences with the approved Product Baseline
- Conduct physical review of the CI and compare the configuration to the proposed baseline documentation; identify any corrective action required

Audits are typically performed at the facilities where the items or their selected subassemblies are produced. The producer shall ensure that suitable facilities and support are available. The most common approach is a product audit in which the selected item(s) is physically compared with its documentation. This approach is usually accomplished incrementally for complex systems by conducting individual audits on selected subassemblies and components leading to a final review at the system level. The items audited should be designated by serial number before their induction into the manufacturing process to minimize the amount of potentially destructive teardown or disassembly. The PCA Plan should identify the specific items to be audited and their respective schedules.

For organizations that are ISO-compliant, a process audit approach can be considered. The approach builds on the ISO process of periodic compliance sampling by identifying and determining if key processes are in place and comply with the organization's ISO certification. To confirm the integrity of this approach, it is recommended that a single item be selected, and a one-time verification of its major processes be accomplished. To be successful, this verification must conclude that the item physically conforms to its design documentation and that all its documentation in the process flow is adequate to support the production and configuration control of that item. The process audit approach includes the following tasks:

- Collect data package inputs for PCA briefing and documentation
- Distribute PCA documentation to stakeholder representatives for review for completeness, correctness, clarity, and organization
- Obtain readiness approval for PCA and comments to the data package made via PCA worksheets.
- Update PCA documentation per the worksheets
- Conduct PCA
    - Report on change status — changes incorporated versus planned corrective actions
    - Report on completeness of all development and design documentation, including planned revisions associated with corrective actions
    - Report on verification of consistency between CI and documentation, including planned corrective actions
    - Report on key issues identified in the review of the PCA documentation
    - Report on risk assessments and mitigation plans
    - Assign responsibility for corrective actions and documentation revisions
    - Obtain stakeholder approval to proceed
- Document and distribute the results of the PCA

- Compile action-item and issues lists
- Track action items and issues via PCA worksheets
- Document and distribute the resolutions of action items and issues

4.2.6.2.2.3 Outputs

The result of a successful PCA is the issuance of a signed PCA certificate. This signifies that the system has demonstrated compliance with its design package and that formal configuration control is ready to be transferred from the implementer to the owner of the item or system. The PCA is complete when the certificate is "unconditional"; that is, issued without any open action items or noncompliances. If there are open action items or noncompliances (documented, tracked, and resolved via PCA worksheets), they are annotated on the PCA certificate, and the certification is considered "conditional." Its status is changed to "unconditional" after all PCA worksheet action plans are completed and accepted by the certifying party. The key outputs of the PCA are:

- Certification that product meets allocated requirements
  - Type A Specification verified
  - Type B Specification verified
  - Type C Specification verified
  - Requirements Allocation Matrix verified
  - ICDs verified
- Completion of all development and design documentation
  - Type A Specification
  - Type B Specification
  - Type C Specification
  - Requirements Allocation Matrix
  - ICDs
  - System Level CONOPS
  - OSED
  - Functional Architecture
  - Physical Architecture
  - CI Description

4.2.6.2.2.4 Metrics

The primary metric is the customer's issuance of a PCA certificate signifying unconditional completion of this milestone. Interim metrics include the number of worksheets generated/open (conditional completion) and/or the number of incremental PCAs completed.

4.2.6.2.2.5 Tools

The primary tools used for this audit are:

- Requirements Database
- Action Item Database
- Issues Database